(NASA-TM-79746) ENVIRONMENTAL STATEMENT FOR NATIONAL AERONAUTICS AND SPACE SCIENCE VIKING 1975 PROGRAM Final Environmental Statement (National Aeronautics and Space Administration) 44 p

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Environmental Statement

for
National Aeronautics and Space Administration
Office of Space Science

Viking 1975 Program

February 1975

SUMMARY SHEET FOR

ENVIRONMENTAL IMPACT STATEMENT

FOR THE

VIKING 1975 PROGRAM

( ) Draft (X) Final Environmental Statement

Responsible Federal Agency:

National Aeronautics and Space Administration
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1. NAME OF ACTION: (X) Administrative Action
( ) Legislative Action

2. BRIEF DESCRIPTION:

The Viking Program is part of an overall NASA program designed to explore the planet Mars with automated spacecraft. The first automated spacecraft exploration of Mars was performed by a flyby Mariner spacecraft in 1964. In 1969, two more Mariner type spacecraft performed flyby investigations of that planet. In 1971, a more extensively modified Mariner spacecraft was placed in orbit about the planet to perform extended scientific investigations. In 1975, two

Viking spacecraft, each consisting of a Lander Capsule and Orbiter, will be launched from the Air Force Eastern Test Range by Titan/Centaur launch vehicles to conduct orbital, upper atmospheric, and surface investigations of Mars.

3. SUMMARY OF ENVIRONMENTAL EFFECTS:

There are insignificant adverse environmental effects from the products of the launch vehicle, spacecraft propulsion system, radioisotope generators, and science instruments' radioactive sources on the spacecraft.

4. SUMMARY OF MAJOR ALTERNATIVES CONSIDERED:

Alternatives considered were: (1) alternative launch vehicles, (2) alternative spacecraft configurations, and (3) alternative Lander Space Power Systems (radioisotope thermoelectric generators, solar panels).

5. COMMENTS:

a. Comments requested from:

Atomic Energy Commission, Department of Defense, Environmental Protection Agency, Department of Commerce, Department of State, and the State of Florida.

b. Comments received from:

Atomic Energy Commission, Department of Defense, Environmental Protection Agency, and Department of State, and the State of Florida.

6. SUBMITTAL DATE:

a. This Final Environmental Impact Statement is being submitted to CEQ and being made available to the public in February 1975.

b. Draft Statement to CEQ on: June 22, 1973.

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1.0 INTRODUCTION

1.1 Background - The Viking Program is part of an overall NASA program designed to explore the planet Mars with automated spacecraft. The first automated spacecraft exploration of Mars was performed by a flyby Mariner spacecraft in 1964. In 1969, two more Mariner type spacecraft performed flyby investigations of the planet. In 1971, a more extensively modified Mariner spacecraft was placed in orbit about the planet to perform extended scientific investigations. In 1975, two Viking spacecraft, each consisting of a Lander and Orbiter, will be launched from the Air Force Eastern Test Range by Titan/Centaur launch vehicles to conduct orbital, upper atmospheric, and surface investigations of Mars.

1.2 Program Objectives and Description - The basic objective of the Viking Project is to advance significantly the scientific knowledge of the planet Mars by means of observations from Martian orbit and direct measurements in the atmosphere and on the surface. Particular emphasis will be placed on obtaining information about biological, chemical, and environmental factors relevant to the existence of life on the planet at this time, at some time in the past, or the possibility of life existing at a future date. Table 1 presents a composite summary of Viking science. Each Viking spacecraft consists of an Orbiter and a Lander Capsule. The Orbiter will obtain visual, thermal, and water vapor information to characterize the Martian atmosphere and surface, to study the dynamic properties of the planet, and to aid in selection of landing sites for Viking and for future missions.

During Lander entry, measurements of temperature, pressure, and composition of the upper atmosphere will be made. After landing, the Lander instruments will visually characterize the landing site, search for evidence of living organisms, characterize the organic and inorganic compounds, and determine the seismic and magnetic properties of the planet. The Lander will also determine the atmospheric composition and its temporal variations as well as the temporal variations of the atmospheric temperature, pressure, and wind velocity. The radio system on the Orbiter and the radio and radar systems on the Lander will be used to investigate the atmospheric and physical characteristics of the planet.

Viking Program Management is provided by the Planetary Programs Office, Office of Space Science. The Langley Research Center, Viking Project Office, has overall Viking Project management responsibility. In addition, the Project Office is responsible for one of the five major systems constituting the Project, the Lander System.

The Jet Propulsion Laboratory has management responsibility for the Orbiter System, Tracking and Data Acquisition System, and Mission Control and Computer System. The Lewis Research Center has management responsibility for the Launch Vehicle System.

1.3 Launch Vehicle and Spacecraft Description

1.3.1 Launch Vehicle - The launch vehicle for this mission will be a Titan-IIIE/Centaur D-1T combination using a 14-ft diameter Centaur Standard Shroud. Launches will be conducted from the Air Force Eastern Test Range, Cape Canaveral, Florida.

The Titan III-E configuration for these missions consists of three stages: Two solid rocket motors that ignite simultaneously at launch and boost the spacecraft off the launch pad, and two liquid bipropellant stages (Titan Stage I and II) that ignite consecutively to further accelerate the space vehicle.

The Centaur Stage has two thrusting periods for these missions. The first accelerates the space vehicle into a 167 kilometer (90 nautical miles) altitude parking orbit. The second, after the desired coast period, further accelerates the combination to the required planetary trajectory. The Centaur Stage is left in a heliocentric orbit following spacecraft separation.

Figure 1 depicts the envelope limits of the instantaneous impact traces for the currently planned launch azimuth range of from 90^{o} to 115^{o} (measured east of north), for the Viking 1975 launches.

1.3.2 Spacecraft - The Viking Spacecraft (Figure 2) including both the Lander Capsule and Orbiter, measures 4.9 meters (16 feet) in length and 3.6 meters (12 feet) in diameter without the solar panels extended. When in flight, the solar panels are extended resulting in a diameter of 9.1 meters (30 feet). The spacecraft, when fully loaded with propellant, weighs about 3600 kilograms (8000 pounds). The Orbiter, which is used to transport the Lander to Mars and insert the spacecraft into Mars orbit, weights about 2310 kilograms (5100 pounds). The Lander Capsule, consisting of the Lander (Figure 3), Aeroshell, and Decelerator encapsulated within the bioshield, weighs about 1132 kilograms (2500 pounds). The Viking Spacecraft Adapter and contingency weight allocated to the launch vehicle account for about 168 kilograms (370 pounds).

Spacecraft systems having environmental significance are the propulsion systems of both orbiter and lander, the power system of the lander, and two of the science instruments (x-ray fluorescence and biology). Primary propulsion for the orbiter (required to place both the orbiter and lander in orbit about Mars) is a bipropellant system using monomethyl hydrazine as fuel and nitrogen tetroxide as oxidizer. The lander uses a monopropellant system, employing hydrazine as its propellant, to provide deorbit and soft-landing capability at Mars.

Each Lander has two hermetically sealed radioisotope thermoelectric generators (RTG's) located on top of the Lander body (Figure 3). The heat source for each RTG consists of a fuel capsule protected by a reentry heat shield (Figures 4 and 5). Each fuel capsule is a multi-layered container containing 18 plutonia molybdenum cermet (PMC) discs with a total radioactivity for each capsule of 20,600 curies, and giving a total activity of 41,200 curies on board each lander. The bulk of radioactivity, approximately 38,600 curies, is from plutonium-238 (half-life of 86.4 years); the remainder is other isotopes of plutonium, viz., approximately 2,540 curies of PU-241 (half-life of 13 years), approximately 26 curies of PU-239 (half-life of 24,000 years), and approximately 20 curies of PU-240 (half-life of 6,600 years).

The strength member for each capsule is 0.229 cm (0.09 inch) thick T-111 (tantalum with 8% tungsten and 2% hafnium) clad with 0.051 cm (0.02 inch) of platinum 20% rhodium. The purpose of the strength member is to provide resistance to mechanical loads. An 0.05 cm (0.02 inch) thick tantalum 10% tungsten liner is within the strength member. The liner serves as an assembly tool which can be readily decontaminated during the manufacturing process. An 0.025 cm (0.010 inch) thick molybdenum 46% rhenium inner liner is around the fuel. Its purpose is to arrest solid-state transport of oxygen from the fuel to the strength member. Three cylindrical sleeves of pyrolytic graphite and a graphite hexagonal heat shield surround the fuel capsule and serve as reentry protection.

The PMC fuel form was especially developed to minimize the creation of respirable PuO_2 particles in potential accident environments such as blast, fire, impact, and reentry. It is made by coating plutonia particles, 105 to 250 microns in diameter, with about 3 microns of molybdenum. The coated material is then vacuum hot pressed to form a disc. The composition of the disc is 82.5 weight per cent PuO_2 and 17.5 weight per cent molybdenum.

Radiation from the fuel is characterized by 5.4 Mev alpha particles, a continuous gamma ray spectrum with less than 1% of the spectral energy contained in photons of over 3 Mev energy, and a continuous neutron spectrum peaking at approximately 1 Mev and with measured energy up to 10 Mev.

The design characteristics of the RTG are presented in Table II. Each Viking RTG is nearly identical to those used on the Pioneer F and G spacecrafts which were launched on March 3, 1972 and April 5, 1973, respectively. A comparison of the Pioneer and Viking RTG's is presented in Table III.

The radioactive sources used in the science instruments consist of 400 millicuries of iron 55(Fe^{55}), 400 millicuries of cadmium 109 (Cd^{109}), 2.0 ± 0.5 millicurie sources of carbon 14 (C^{14}) (12% carbon monoxide and 88% carbon dioxide), and 0.272 ± .07 millicurie sources of carbon 14 of various organic solutions.

The iron 55 has a half life of 2.6 years and emits x-rays, the cadmium 109 has a half life of 470 days and emits gamma particles at 0.088 Mev, and the carbon 14 has a half life of 5,600 years and emits beta particles at 0.156 Mev.

The radioactive iron and cadmium are used as x-ray sources for performing elemental analysis of the Martian soil. The carbon sources are used as tracer elements in identifying any metabolic activity which may occur if there is indigenous life on Mars.

1.4 Mission Sequence - Two spacecraft will be separately launched by Titan/Centaur launch vehicles (second launch is not sooner than 10 days after the first) from the Air Force Eastern Test Range (AFETR) at Cape Canaveral in August of 1975. After nearly one year in transit to Mars, each spacecraft will be inserted into Mars orbit. The science instruments on the Orbiters will be used during Mars approach and after achieving Mars orbit to perform scientific investigations. After insertion into orbit, these instruments will survey pre-selected landing sites for confirmation of their acceptability and, should the pre-selected sites prove unacceptable, survey alternate landing sites. After as much as a 50-day orbital period, the Landers will separate from the Orbiters, perform a deorbit maneuver, descend through the Martian atmosphere, and soft-land on the surface of Mars (the second spacecraft will land approximately two months after the first). During descent the Landers will make scientific measurements of the upper atmosphere. Each Lander will have the capability of operating on the surface for 90 days. During this time the experiments listed in Table I will be performed. Although the Landers have the capability of transmitting data directly to earth, the Orbiters are used as relay stations to increase the amount of data which can be returned from the Landers. While passing over the Landers, the Orbiters will obtain periodic visual, thermal, and water vapor information about the area surrounding the Landers.

2.0 ENVIRONMENTAL EFFECTS

2.1 Launch Vehicle - Effects on the environment due to normal and abnormal operations of the Titan-Centaur launch vehicle are covered in the Environmental Statement for NASA, Office of Space Sciences, Launch Vehicle and Propulsion Programs Document (Reference 1).

2.2 Spacecraft

2.2.1 Prelaunch Operations - The only aspects of the Viking missions that could be considered to have environmental significance are (1) release of exhaust products of the Orbiter and Lander propulsion systems and (2) possible release of radioactive materials from the Radioisotope Thermoelectric Generators (RTG's) which provide electric power to the Lander or the science instruments containing radioactive material. The spacecraft propulsion systems are fired within the earth's atmosphere only for systems tests. The propellants used in these systems (nitrogen tetroxide, hydrazine, and monomethyl hydrazine) are used in quantities orders of magnitude smaller than the amounts used in the Titan launch vehicle. The environmental effects are insignificant.

During the pre-launch operations, some operational personnel will be exposed to direct gamma and neutron radiation from the RTG's. The exposure of these personnel will be minimized by shielding, controlling their distance of closest approach and limiting work times around the generators. This will limit the exposures to individuals such that they will not exceed those limits (Reference 2) recommended by the National Committee for Radiation Protection and the Federal Radiation Council (now part of the Office of Radiation Programs, Environmental Protection Agency).

However, the radioactive sources for the science instruments are not handled during pre-launch operations. They are sealed in steel capsules or ampoules that have been installed in sealed sections of the instruments. Only the instruments are handled during installation and these pose no radiation problem.

2.2.2 Normal Launch - For a normal launch, the Viking spacecraft will have no effect on the earth's environment because it is placed into a heliocentric trajectory and will never encounter the earth.

Major consideration has been given in the Viking Program to protection of the environment of the target planet, Mars. From the early days of the space program it was postulated that, as man extended his presence to the moon and planets, changes in the environments of those bodies could result from biological contamination by incautious space explorations. On October 10, 1967 a United Nations Outer Space Treaty came into force which requires the states party to the treaty to conduct exploration of celestial bodies so as to avoid their harmful contamination and adverse changes in their environments. The internationally accepted criterion for planetary quarantine is that there be only a one in one-thousand (0.001) probability of contamination by terrestrial organisms during the fifty year period beginning January 1, 1969.

Because there may be many spacecraft exploring Mars during the fifty year period, NASA has established more stringent quarantine requirements; less than one in ten-thousand (0.0001) probability of contamination for each Viking launch. These planetary quarantine requirements for Viking (Reference 3) are being met by many measures, three of the principal ones being: (1) trajectory and orbit control; (2) manufacturing cleanliness; and, (3) Lander sterilization (Reference 4). Trajectory control biases the initial planetary trajectory away from Mars so as not to accidently impact the planet with unsterilized spacecraft hardware should the retro systems fail during interplanetary flight. The Mars orbiting parameters and strategy are carefully selected so as not to accidently impact the planet with the unsterilized Orbiter for the decades required by quarantine. The Orbiter and Lander are both manufactured in special clean room facilities to reduce the levels of microbial contamination to predefined allowable levels. The Lander is subsequently heat sterilized in special ovens to assure that the microbial burden carried to Mars and the probability of releasing terrestrial organisms on Mars is below the required levels for planetary quarantine.

2.2.3 Abnormal Launch - Abnormal launches can result in the impact on the earth of spacecraft materials. Spacecraft materials of significance which could return to the earth's surface if a launch abort occurred are listed in Table IV. The steel, aluminum, and copper constitute the Spacecraft structure, tanks, antennas, mechanical devices, electrical devices, and wiring, etc. The ablative material, used on the aeroshell for entering the Martian atmosphere, consists of silicone rubber and cork. These materials are not considered serious pollutants and all are relatively insignificant in total mass.

Nitrogen tetroxide, hydrazine, and monomethyl hydrazine are contained in the Spacecraft propulsion systems (Figures 2 and 3) and for normal missions would not be burned until after the Spacecraft leaves the earth. The spacecraft propellants are the same as or very similar to those specified in the launch vehicles environmental statement (Reference 1), with similar maximum allowable concentrations. The amounts of these propellants in question for the spacecraft propulsion systems are small compared to those of the launch vehicle and therefore will have insignificant environmental effects should they be released or burned in the atmosphere during an abort.

Potential environmental impact due to the radioactive material in the science instruments and the fuel elements of the RTG's must be considered for abnormal launches which may result in dispersal of these substances. Dispersal itself may result from atmospheric entry heating, impact in the ocean or on land, or corrosion. The probability of abort at various times in the mission, the corresponding probability of fuel release from the RTG's, and the resulting exposures to those radioactive substances have been calculated (Reference 5) for the Viking systems and mission profile. No calculation for the release of the radioactive material contained in the science instruments has been made due to the very small amount of material involved. Relevant results from the analysis of the RTG fuel are summarized in the following paragraphs.

2.2.3.1 Abort Probabilities - The abort probabilities of Reference 5, which are based upon subsystems and systems failure rate data, have been modified in the direction of increased conservatism reflecting previous spaceflight experience with the Titan/Centaur and similar launch vehicles (Reference 6). The predicted probability of achieving a normal launch is approximately 0.94. Those abnormal launches in which the spacecraft escapes from the gravitational attraction of the Earth also will not involve any environmental effect different from a normal launch; their probability, however, is only about 0.002. Therefore the probability that a radioactive system will not return to Earth is about 0.94, and the probability that a system will return to Earth is about 0.06.

The 0.06 probability of failure with return to Earth is subdivided into those that fail during ascent to orbit (probability of about 0.04) and those that fail in orbit (probability of about 0.02). The former will lead almost entirely to ocean impact (probability of land impact less than one in one thousand); instantaneous impact points for abort during ascent are shown in Figure 1. If failure is in orbit, there is approximately a 75-percent probability of ocean impact. Thus the most likely area of impact in the case of Earth return is the ocean. Finally, the probability of abort near the launch pad is estimated to be less than 0.001.

2.2.3.2 Nuclear Criticality - First, it should be noted that, regardless of event, there is no possibility of a nuclear criticality incident because the total quantity of plutonium dioxide (about 3 kilograms) is less than a critical mass (8.6 kilograms) even in a most-reactive geometry.

2.2.3.3 Probability of Fuel Release - An extensive safety testing program was conducted to determine the response of the heat source to severe abort environments at any point in the launch phase from launch to Earth escape. These environments included launch dynamic environments, severe aerothermodynamic stresses occurring during atmosphere reentry, hard impact, booster explosion, and penetration from shrapnel on the launch pad. Both analytic and experimental tests were included. The results of these studies lead to the conclusion that the probability of any fuel being released is about one in a thousand.

2.2.3.4 Radiological Effects - If the fuel capsules do return to Earth, the most likely impact area would be in the ocean. In the event impact in the water occurs early in flight, acoustic beacons ("pingers"), placed on the vehicle near the spacecraft, would be actuated to assist in the location of the nuclear systems. If the systems are at recoverable depths, they will be returned to radiological control.

Should recovery from the ocean not be possible, it is likely that dissolution would eventually take place. The capsule materials and the fuel form have extremely low solubility; nevertheless water would be expected to diffuse into the capsule and slowly dissolve the plutonium, with the dissolved plutonium slowly diffusing out of the capsule. Because of the extremely low rate of dissolution, such a series of events would take hundreds of years, during which time the radioactive Pu-238 would be decaying to somewhat less hazardous materials.

The effect of dissolution of plutonium in sea water has been calculated. Analyses conducted by the <u>Ad</u> <u>Hoc</u> Marine Subpanel on the Safety Evaluation of the SNAP 27/ALSEP, a similar RTG system, assumed that 3,800 grams of Pu-238 fuel was exposed to the ocean environment (Viking RTG's contain 3,000 gm). With an experimentally established dissolution rate of 0.25 Ci/day, conservative calculations (using 0.50 Ci/day) show that even if a man were to obtain his entire annual protein diet from fish (75 kg of protein from 150 kg of fish) grown in the contaminated area, the maximum annual intake of Pu-238 would be 0.08µ Ci. This is to be compared to a maximum permissible intake of 4µ Ci/year (Reference 2).

In summary, using the most recent data on concentration factors, the conclusion drawn from the SNAP 27 analyses is that the amount of Pu-238 which can possibly find its way into the human diet through the marine biota would be well within established limits.

The effects of radiation dose on marine organisms has also been analyzed. The highest Pu concentration factor that has been observed for marine animals was that for zooplankton reported by Pillai, et al. (7) Studies performed by the <u>Ad</u> <u>Hoc</u> Marine Subpanel on the Safety Evaluation of the SNAP 27/ALSEP showed that Pu-238 concentrations of 1×10^{-7} Ci/m^3 would be produced in $1.5 \times 10^6 m^3$ of sea water from a continuous source of 0.5 Ci/day on the continental shelf. (7) Assuming a concentration factor of 2590 for zooplankton, the resultant concentration of Pu-238 in zooplankton would be 0.26µ Ci. This activity concentration delivers approximately 26 rads/yr of alpha radiation to the plankton. The effects of such dose rates cannot be predicted accurately, but the biomass of plankton involved would be very small.

To release fuel upon reentry requires extreme conditions including high velocity, ablation of the graphite heat shield and protective sleeves, and penetration of structural capsules encasing the fuel elements. The probabilities of these occurrences and the likely exposures have been carefully analyzed (Reference 5). The results of these analyses show that there is less risk associated with the Viking mission than with the earlier missions Nimbus, Apollo, and Pioneer. Table V is a summary of the risks for internal exposure of radioactive RTG fuel for these previous missions, where the probability of one or more individuals accumulating greater than 0.016 microcuries in the lungs is shown for various population densities. For exposures less than 0.016 microcuries, no significant health effects are expected.

Should an abort occur near the launch pad, the capsule will be recovered and returned to the Atomic Energy Commission for reprocessing and reuse of the fuel. When the probability of launch pad abort (less than 0.001) is combined with the probability of fuel release (about 0.001), the resulting probability of fuel release resulting from a launch pad abort is less than one chance in a million. If any fuel is released, only a small fraction would be respirable, and it is unlikely that anyone would receive a lung burden of as much as 0.005 microcuries (5 rem per year), the level established as the limit for the general public.

Despite the extremely low failure probability, contingency plans have been formulated to further reduce the possibility of individuals being exposed to radioactive material. To implement these plans, a Radiological Control Center will be in operation during the pre-launch, launch and ascent phases of the missions. The Center will be manned by safety and medical representatives from NASA, DoD, AEC, and EPA and will be able to: rapidly determine if a release of radioactive material has occurred; rapidly assess the extent of radiological dispersion, if any; protect people; decontaminate required areas; and remove radioactive material.

3.0 ALTERNATIVES

The range of alternatives available for this next step in the exploration of Mars ranges from no mission at all to extremely ambitious missions considerably beyond the state of the art. The current Viking mission and systems concept represents a compromise that provides significant potential scientific return in a timely manner and at acceptable economic cost. Environmental effects in all of the primary concepts considered were not of major significance.

The Titan/Centaur launch vehicle was among the launch vehicles considered for the spectrum of missions and was selected consistent with mission objectives. The environmental effects of the class of launch vehicles considered are presented in Reference 1.

A number of alternative spacecraft configurations were analyzed during the planning phases of the Viking Program before the present one was selected. These alternatives did not differ significantly in terms of environmental impact with one exception. The use of solar panels on the Lander was considered as an alternate to the use of Radioisotope Thermoelectric Generators (RTG's) for the generation of electrical power. However, this alternative has the following disadvantages:

- The Martian atmosphere is known to contain relatively large quantities of "dust" which would soon reduce the effectiveness of the solar cells imposing an unacceptable risk to mission success.

- During Martian night the solar panels would not produce electrical power, necessitating the use of additional batteries or radioisotope heaters to maintain Lander temperatures to insure survival during the cold nights.

- The reliability of the solar panels in terms of deployment and proper orientation to the sun was considered unacceptable.

Selection of the RTG power system was based upon its performance advantages and the low risk of release of radioactive materials.

4.0 RELATIONSHIP BETWEEN LOCAL SHORT TERM USE OF MAN'S

ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

The short-term use of the environment in this program will contribute to long-term productivity because of the knowledge which will be accrued. The scientific investigation of Mars by Viking is a first step in a comparative study of the meteorology geology, biology, chemistry, and physics of that planet and the earth. Scientific data, most of which was provided by the Mariner 9 mission in 1971, indicate that Mars is an active planet geologically, possessing large volcanoes, deep trenches, faults, and even exhibiting continental drift characteristics similar to earth. There is interesting meteorology on Mars also. But probably one of the most interesting Martian features discovered by Mariner 9 was an extended region of eroded features which some scientists declare can only be explained in terms of water erosion (e.g., by rivers), suggesting that at some time during its history Mars had considerable amounts of liquid water so crucial to life as we know it here on earth. If this is true, then the evolutional process which has resulted in the present apparent absence of this water is of profound significance in understanding the evolution of the planets in general and the earth in particular.

When identifying the most important objectives of NASA's planetary exploration program and the means of achieving them, the Space Science Board of the National Academy of Sciences recommended that a high priority be assigned to the investigation of Mars, with scientific instruments to be landed on the surface.

The Board recognized the importance of the search for extraterrestrial life, stating in its 1968 Study Report, "The Space Science Board and its various panels have on frequent occasions emphasized the great importance of the investigation of Mars for the purpose of detecting possible biological activity. The discovery of life on Mars would rank as one of the great events of this or any other century."

If life exists on Mars even in its most primitive and elementary state, it suggests a universality of life that has hitherto been only conjecture. Further, it might provide answers to the origin of terrestrial life, one of today's most intriguing scientific mysteries.

Answers to scientific questions unrelated to biology will result from the exploration of Mars. Recognizing this, the Space Science Board recommended a general planetary environmental investigation to provide certain scientific data related to our understanding of the earth's atmosphere and geological processes.

Mars is an evolving planet whose physical characteristics differ dramatically from those of earth. Investigations of Mars and the other planets will reveal more about how the planets themselves were formed and the physical and biological forces that influence and control the evolution of a planet. Comparative studies of Mars will help in understanding the processes changing the earth, enabling mankind to predict and ultimately to control those processes which affect our lives.

The search for answers to these profound questions, which Viking is designed to obtain, justifies the short-term use of the environment.

5.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF NATURAL RESOURCES

The launch vehicle and spacecraft consist of materials which are irretrievable once the launch process is initiated. However, the materials are relatively easily replaced and, in general, are replaceable from domestic resources with relatively insignificant expenditure of manpower and energy.

The largest weight of materials making up a launch vehicle are the propellants. These have previously been enumerated and defined in the NASA/OSS launch vehicle environmental statement (Reference 1).

In addition to propellants, other material constituents of the launch vehicle and spacecraft include metals such as steel, aluminum, nickel, chromium, titanium, iridium, lead, zinc, copper, silver, gold and platinum. Other materials include plastics and glass and plutonium dioxide. The quantities of materials of various kinds which are utilized are insignificant.

6.0 REFERENCES

(1) "Environmental Statement for NASA/OSS Launch Vehicle and Propulsion Programs," Final Statement, National Aeronautics and Space Administration, July 1973.

(2) Title 10, Code of Federal Regulations, Part 20 (for AEC-Licensed facilities); AEC Manual, Chapter 0524 (for AEC contractors).

(3) "Viking '75 Program-Planetary Quarantine Plan," NASA Report M75-149-0, 1974.

(4) "Viking '75 Program - Lander Capsule Sterilization Plan," NASA Report M75-147-0, 1974.

(5) "SNAP 19 Viking, Final Safety Analysis Report," Volumes I to IV, Teledyne Isotopes Report ESD-3069-15-1 to 4, Prepared for the United States Atomic Energy Commission under Contract AT (49-15)-3069, August 1974.

(6) Addendum (in preparation) to "Viking AEC Safety Study, Phase 2," General Dynamics Convair Aerospace Report No. CASD/LVP73-026, December 18, 1973.

(7) Pillai, K.C.; Smith, R.C.; and Folsome, T.R., "Plutonium in the Marine Environment," Nature, Vol. 203, No. 4945, August 3, 1964, pp. 68-9.

7.0 TABLES

TABLE I

VIKING SCIENTIFIC EXPERIMENTS

INSTRUMENTS	MEASUREMENTS	GOALS
ENTRY:	ENTRY:	ENTRY:
RETARDING POTENTIAL ANALYZER MASS SPECTROMETER TEMPERATURE TRANSDUCERS PRESSURE TRANSDUCERS ACCELEROMETERS RADAR	IONOSPHERIC PROPERTIES ATMOSPHERIC COMPOSITION ATMOSPHERIC STRUCTURE	DESCRIBE THE PHYSICAL, CHEMICAL AND THERMAL PROPERTIES OF THE UPPER AND LOWER ATMOSPHERE
LANDED:	LANDED:	LANDED:
FACSIMILE CAMERAS BIOLOGY INSTRUMENT GAS CHROMATOGRAPH/MASS SPECTROMETER SOIL SAMPLER MAGNETS SEISMOMETER PRESSURE TRANSDUCERS TEMPERATURE TRANSDUCERS ANEMOMETER X-RAY FLUORESCENCE SPECTROMETER RADIO	BIOLOGICAL ORGANIC ATMOSPHERIC COMPOSITION METEOROLOGICAL SEISMIC MAGNETIC (SOIL) PHYSICAL (SOIL) WATER (SOIL) INORGANIC	SEARCH FOR LIFE AND LIFE-RELATED PHENOMENA AND DESCRIBE THE PHYSICAL, CHEMICAL, THERMAL AND MAGNETIC PROPERTIES OF THE SURFACE AND SURFACE ATMOSPHERE AND THE STRUCTURE OF THE PLANET
ORBIT:	ORBIT:	ORBIT:
TELEVISION IR RADIOMETER IR SPECTROMETER (H_2O) RADIO	VISUAL MAPPING THERMAL MAPPING WATER VAPOR MAPPING	DESCRIBE THE STATIC AND DYNAMIC THERMAL AND WATER VAPOR PROPERTIES OF MARS ATMOSPHERE AND SURFACE AND VISUALLY CHARACTERIZE THE LANDING SITES AND SELECTED SURFACE REGIONS

Table II

VIKING RTG DESIGN CHARACTERISTICS

Housing/Radiator Assembly

Configuration	Finned cylinder
Material	MgTH (HM21A)
Type gas seal	Seal-weld
Emissive coating	Zirconia with sodium silicate binder
Minimum cylinder OD (cm.)	16.357
Minimum cylinder wall thickness (cm.)	0.236
Overall length (cm.)	28.702
Overall diameter, including fins (cm.)	58.420
Number of fins	6
Fin dimensions	
Length, root-to-tip (cm.)	20.955
Height (cm.)	26.518
Root thickness (cm.)	0.635
Tip thickness (cm.)	0.076

Thermoelectric Converter Assembly

Conversion materials	TAGS-85/2N
Number of thermoelectric modules	6
Number of thermoelectric couples	90
N-element dimensions	
Diameter (cm.)	0.958
Length (cm.)	1.270
P-element dimensions	
Diameter (cm.)	0.686
Length (cm.)	0.254 SnTe + 0.400 TAGS
Thermal insulation	Johns-Manville Min-K Type 1301
Number of parallel-series strings	2
Cold-end hardware	
Material	A-(6061-T6); SS springs
Number of heat sink assemblies	6
Power output receptacle gas seal	Diffusion bond/weld
Cover gas	Argon/helium mixture
Heat shield	
Configuration	Right hexagonal prism with three concentric cylindrical sleeves
Materials	POCO AXF-Q1 graphite hexagonal prism; pyrolytic graphite cylindrical internal sleeves

Table II (continued)

Radioisotope Heat Source Assembly

Radioisotopic fuel	PuO_2 (plutonia molybdenum cermet)
Fuel Capsule Configuration	Four-layer, vented capsule with graphite reentry protection
Innerliner	Mo 46 Re
Liner	Ta-10%W
Strength member	T-111
Outer clad	Pt-20% RH

Table III

RTG COMPARATIVE DESIGN DESCRIPTION

	SNAP 19 PIONEER	SNAP 19 VIKING
Overall Size (Lg. X Dia. cm.)	28.45 x 50.80	28.70 x 58.42
Generator Weight (kg)	13.605	15.420
BOL Power Output (watts(e))	40	42
BOL Fuel Inventory (watts(t))	645	682
BOL Pu-238 Inventory (curies)	19,500	20,600
Heat Shield Length (cm.)	16.510	17.048
Capsule Length (cm.)	12.184	12.723
Capsule Inner Liner Thickness (cm.)	0.013	0.023
Capsule Weight (kg)	3.447	3.629
Generator Internal Gas Fill (%)	75 He/25 Ar	90 He/10 AR
Capsule Gas Fill (%)	75 He/25 Ar	100 He
Capsule Strength Member Temp. (^{o}F)	1460 (on load)	1426 (short circuit)
Capsule Vent Tube	No	No
Head Shield Getter Recess	No	Yes
End Cover Attachment	Bolter/Seal Weld	Lock Ring/Seal Weld
Electrical Receptacle Seal	Viton O-Ring	Double Viton O-Ring

Table IV

Spacecraft Materials

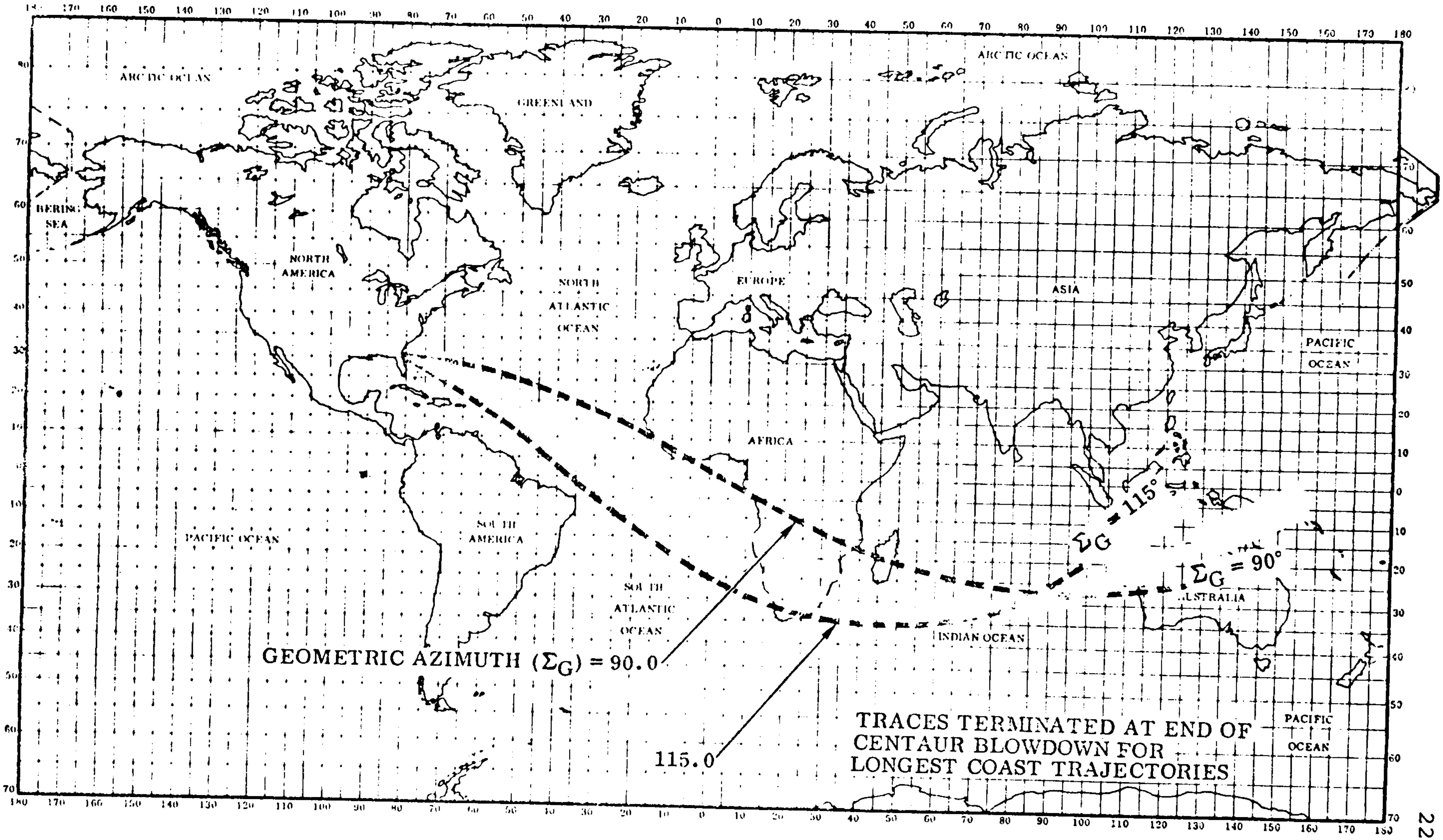
Material	Weight (kg)	Weight (lb)
Steel	544	1,200
Aluminum	1,134	2,500
Copper	136	300
Ablatives	23	50
Nitrogen Tetroxide (N_2O_4)	680	1,500
Hydrazine (N_2H_4)	153	337
Monomethyl Hydrazine ($CH_3N_2H_3$)	726	1,600
Plutonium Dioxide ($^{238}PuO_2$)	3	7
Carbon 14 (C^{14})	5.7m gm	0.2m oz.
Cadmium 109 (Cd^{109})	130μ gm	4.58 μ oz.
Iron 55 (Fe^{55})	330μ gm	11.64 μ oz.

Table V

Summary of Risks for Random Impact

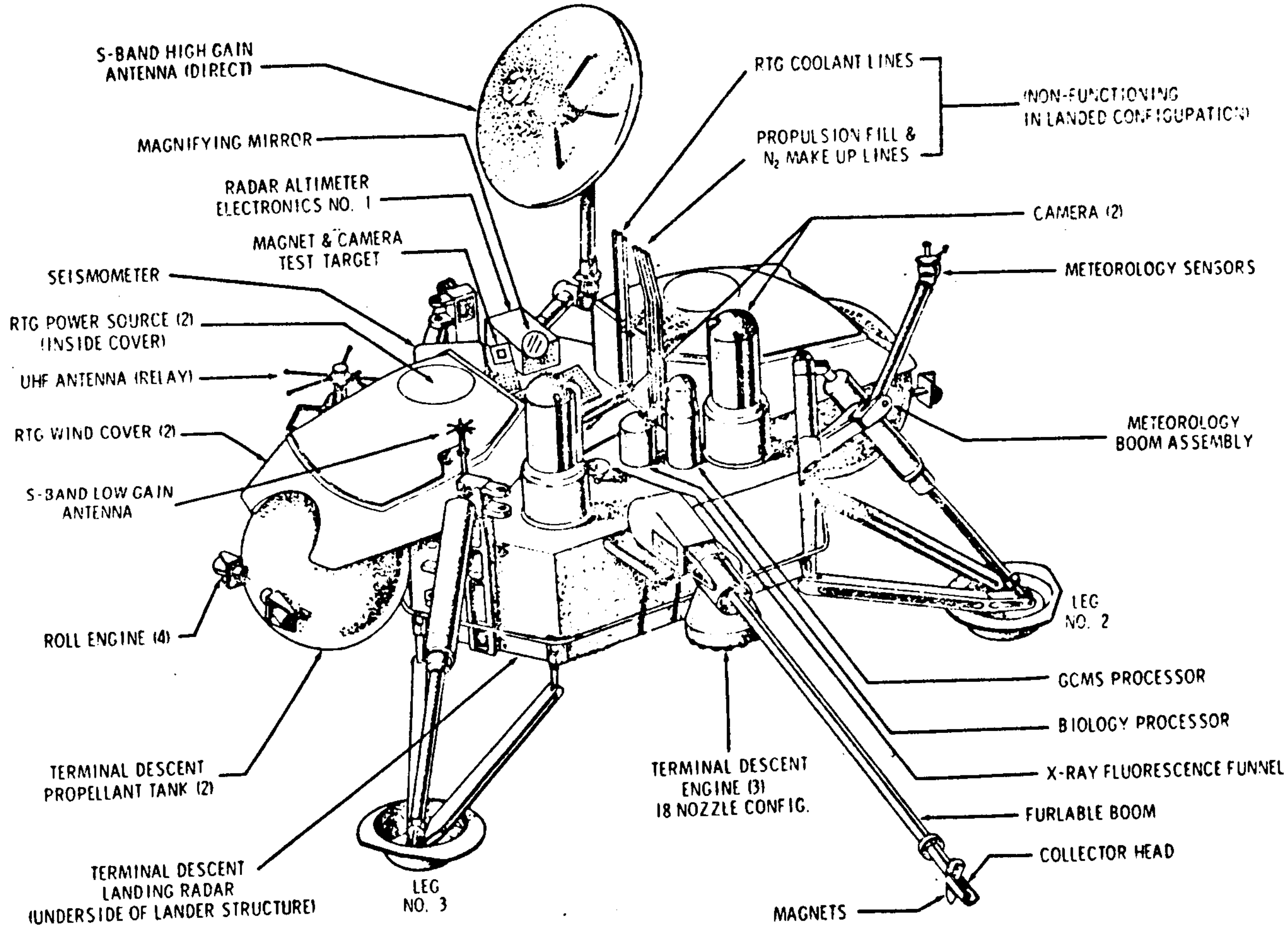
Population Densities (people/square mile)	Probability of one or more individuals accumulating greater than 0.016 μci in the lungs		
	Nimbus	Apollo	Pioneer
0 - 1	8.1×10^{-4}	3×10^{-4}	3×10^{-4}
1 - 100	8.3×10^{-4}	6×10^{-4}	3×10^{-4}
100 - 500	8.5×10^{-5}	9×10^{-5}	5×10^{-5}
500 - 1000	1.4×10^{-5}	2×10^{-5}	1×10^{-5}
1000 - 5000	9.0×10^{-6}	6×10^{-6}	5×10^{-6}

8.0 FIGURES



NOMINAL INSTANTANEOUS IMPACT POINT TRACES FOR VIKING '75

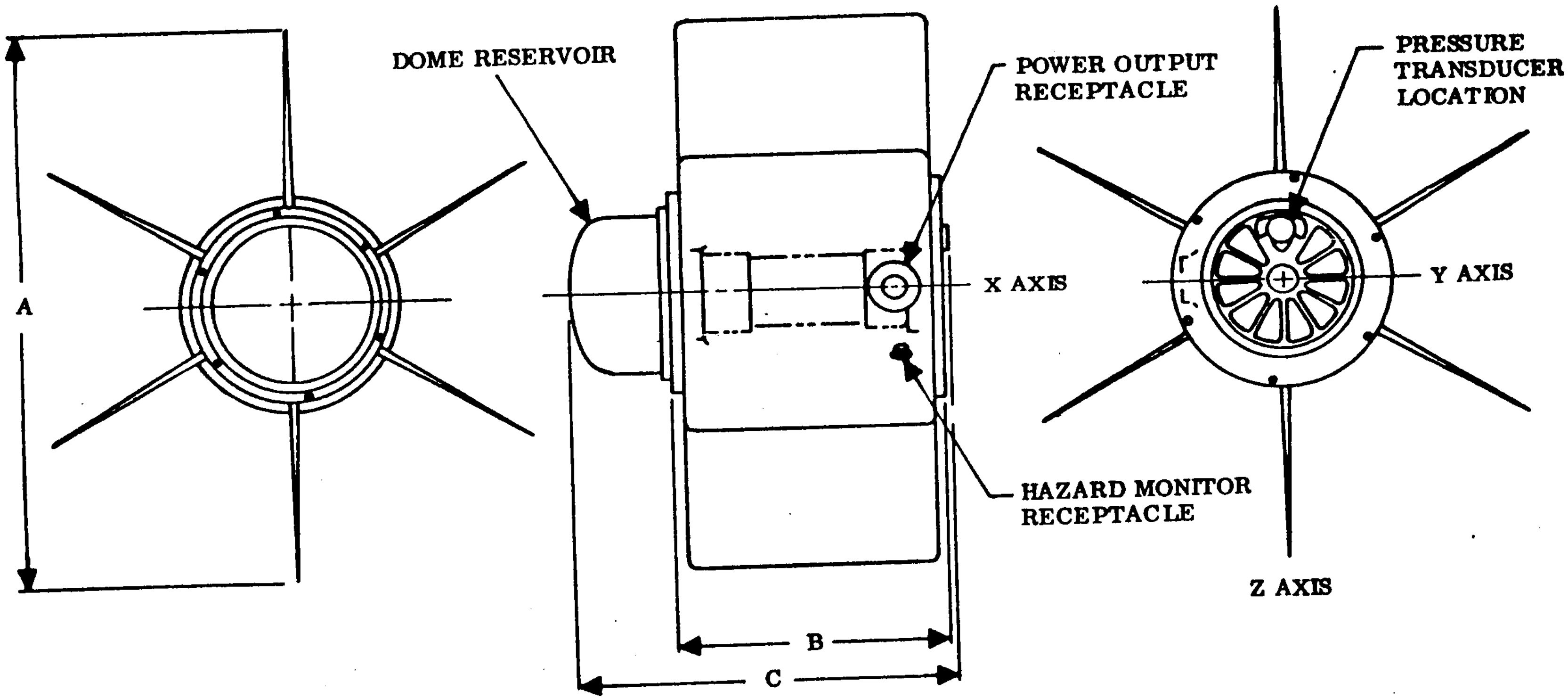
FIGURE 1



VIKING LANDER (DEPLOYED)

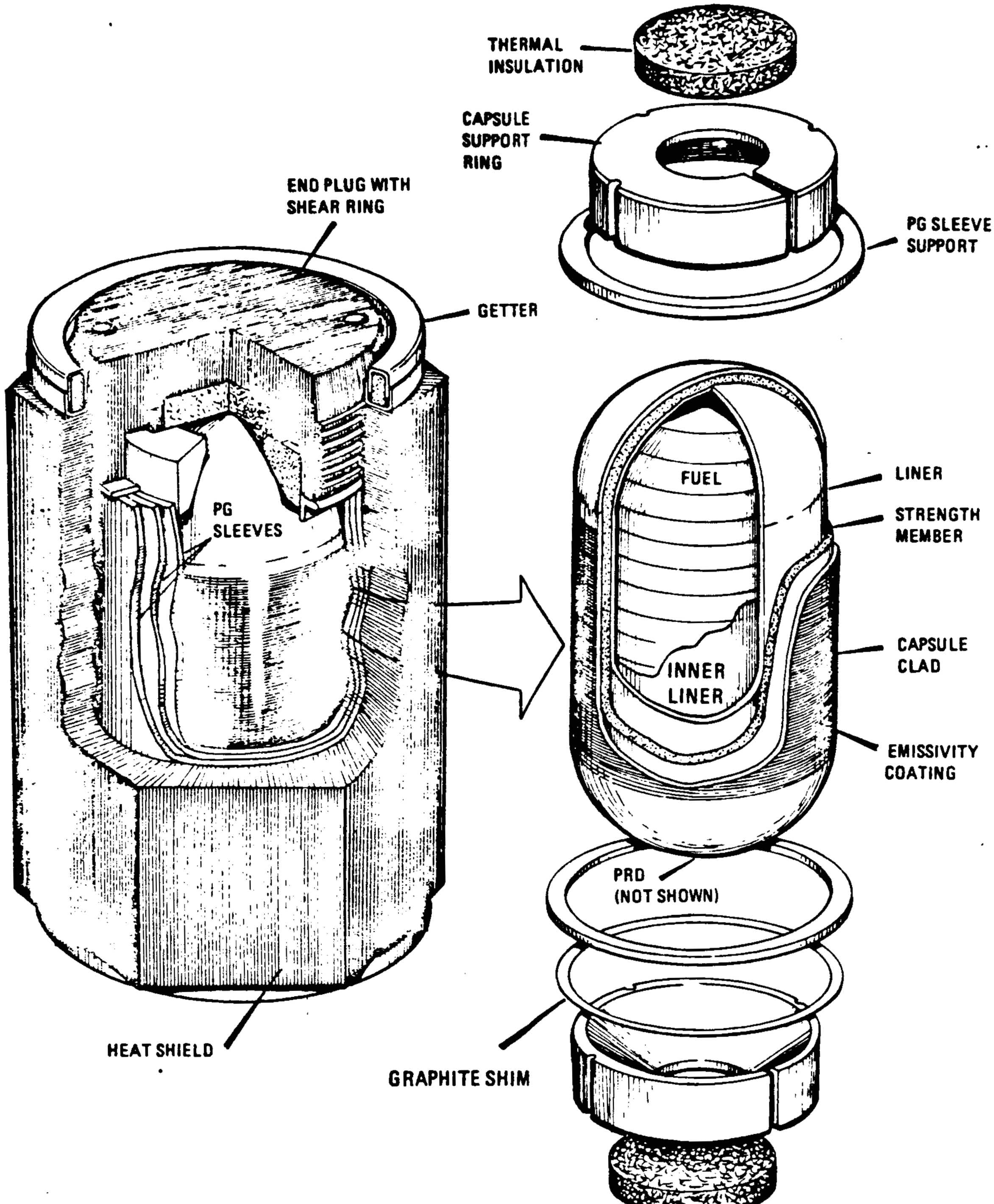
FIGURE 3

DIMENSION	ITEM	MAXIMUM INTERFACE DIMENSION	ACTUAL BASELINE DESIGN (MAXIMUM)
A	OVERALL DIAMETER	23.1 cm	23.02 cm
B	FLANGE-TO-FLANGE HEIGHT	12.0 cm	11.352 cm
C	OVERALL HEIGHT	15.925 cm	15.622 cm



Radioisotope Thermoelectric Generator (RTG)

Figure 4



Radioisotope Thermoelectric Generator (RTG)

Fuel Cell

Figure 5

9.0 RESPONSE TO COMMENTS ON DRAFT

The draft environmental statement for the Viking Project was circulated in June 1973; comments were received from the Department of State, the Atomic Energy Commission, and the Environmental Protection Agency and the State of Florida. The Department of Defense had no comments. The comments are contained in the Appendix. Comments of the Department of State and the AEC have been incorporated into the text of this final environmental statement. The comments of EPA are discussed separately in the following paragraphs:

9.1 Radiological Aspects

Comment: In addition to the probabilities of land and water impact after orbital lifetimes of less than 1000 years, the final statement should also estimate the accompanying potential release (in curies) to the environment, and the environmental levels of plutonium which may be present.

The analysis of the potential radiological effects should include a discussion of the maximum individual and population doses which could occur following the possible accident and abort situation. The analysis should assume that these situations occur under the worst case meteorological conditions which may lead to dispersion of plutonium to the biosphere.

Response: The discussion in this final environmental statement has been expanded to include probabilities of radioactive fuel release and potential radiological effects (Section 2.2.3). In addition, Table V shows the probability of one or more individuals accumulating a lung burden greater than 0.016 microcuries for release of the materials from the RTG's employed in the Nimbus, Apollo, and Pioneer programs. These probabilities are shown as a function of population density. No significant health effects are anticipated for exposures less than 0.016 microcuries. Specific probabilities of exposure to radioactive materials and the likely population/dose estimates are provided for Viking in the classified Volume 4 of Reference 5. These analyses indicate that there will be less risk associated with the Viking Program than for each of the three previous programs for which data are provided in Table V.

Comment: The discussion of the environmental consequences resulting from reentry after an orbital lifetime of less than 1000 years should consider possible land food chains in addition to the aquatic food chains currently evaluated.

Response: The probability that a radioactive system will fail in short-lived orbit and eventually reenter the atmosphere and impact on land is less than 0.005. Analyses and tests of the effects of ingested plutonium on land life forms indicate that the associated hazard is significantly less than the hazard of inhaling plutonium. The inhalation hazard is discussed in the text and shown to be small.

Comment: The number of people who may be exposed and the resultant health effects should be discussed.

Response: As noted previously, specific estimates of number of people that might be exposed are in the classified Volume 4 of Reference 5. Table V provides the probabilities of persons accumulating a lung burden greater than 0.016 microcuries as a function of population density.

9.2 Non Radiological Aspects

Comment: The draft statement does not discuss the impact of noise on the environment. We recommend that the final statement include a discussion of the noise including the following specific items:

1) Delineation of launch site zones showing predicted noise contours in uncontrolled areas during the launch of the Titan/ Centaur launch vehicles.

2) A discussion of the procedures and practices to be used for notification of municipalities in the vicinity of the launch site of the launching schedule in order to minimize potential response.

Response:

1) Noise information, although not included in the draft version of Reference 1 (which was the version available when the Viking draft was released) is contained in the final version of Reference 1.

2) It is unlikely that municipalities within the range where launch noise will be heard will be unaware of the Viking launch schedule. The uniqueness of this program makes adverse community reaction unlikely.

Comment: In addition to the Federal Organizations currently being requested to comment on the Draft Statement, comments should also be requested from the State of Florida, since the launch will be from the Air Force Eastern Test Range located there.

Response: The Institutional Statement for the Kennedy Space Center, which covers all activities at the installation, has been sent previously to the State of Florida. Concerned Florida State and Brevard County Offices have been provided draft copies of the "Viking 1975" Final Environmental Impact Statement.

10.0 APPENDIX

Comments received from the Environmental Protection Agency, Department of State, Department of Defense, the Atomic Energy Commission, and the State of Florida.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP 20 1973

Mr. Nathaniel B. Cohen
Director, Office of Policy Analysis
National Aeronautics and
Space Administration
Washington, D.C. 20546

Dear Mr. Cohen:

The Environmental Protection Agency has reviewed the draft statement for NASA "Viking 1975 Program" and our comments are enclosed.

Radiological Aspects

Our principal radiological concern is with the potential release, to the environment, of any of the 82,400 curies of plutonium-238 employed in this proposed program, and in the case of airborne plutonium, the potential of particulate resuspension and redistribution. While the PMC ceramic discs are a preferable chemically inert and non-respirable form, further assessments of accidental releases during abnormal missions are necessary before a final conclusion can be reached concerning the acceptability of the potential radiological impact on the environment. In order to allow EPA to reach such a conclusion, the following technical information and/or analyses should be included in the final statement:

1. In addition to the probabilities of land and water impact after an orbital lifetime of less than 1000 years, the final statement should also estimate the accompanying potential release (in curies) to the environment, and the environmental levels of plutonium which may be present.

2. The analysis of the potential radiological effects should include a discussion of the maximum individual and population doses which could occur following the possible accident and abort situations. The analysis should assume that these situations occur under the worst case meteorological conditions which may lead to dispersion of plutonium to the biosphere.

U.S. Environmental Protection Agency Procedures for Classifying Federal Projects and Associated Draft Environmental Impact Statements

Environmental Impact of the Project

LO--Lack of Objections

EPA has no objections to the proposed project as described in the draft impact statement; or suggests only minor changes in the proposed project.

ER--Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed project. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to reassess these aspects.

EU--Environmentally Unsatisfactory

EPA believes that the proposed project is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this project. The Agency recommends that alternatives to the project be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1--Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project as well as alternatives reasonably available to the project.

Category 2--Insufficient Information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3--Inadequate

EPA believes that the draft impact statements does not adequately assess the environmental impact of the proposed project, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement.

If a draft impact statement is assigned a Category 3, no rating will be made of the project, since a basis does not generally exist on which to make such a determination.

3. The discussion of the environmental consequences resulting from reentry after an orbital lifetime of less than 1000 years should consider possible land food chains in addition to the aquatic food chains currently evaluated.

4. The number of people who may be exposed and the resultant health effects should be discussed.

Non-Radiological Aspects

The draft statement does not discuss the impact of noise on the environment. We recommend that the final statement include a discussion of the noise including the following specific items:

1. Delineation of launch site zones showing predicted noise contours in uncontrolled areas during the launch of the Titan/Centaur launch vehicles.

2. A discussion of the procedures and practices to be used for notification of municipalities in the vicinity of the launch site of the launching schedule in order to minimize potential community response.

With regard to air and water quality, we foresee no adverse environmental impact except in the event of an aborted mission.

In addition to the Federal organizations currently being requested to comment on the draft statement, comments should also be requested from the State of Florida, since the launch will be from the Air Force Eastern Test Range located there.

In our review of the draft statement for NASA "Viking 1975 Program" in accordance with EPA procedures, we have classified the project as ER (Environmental Reservations) and rated the draft statement as Category 2 (Insufficient Information). We have enclosed a detailed explanation of our classification system for your information. Additionally, we will be pleased to discuss our classification of comments with you or a member of your staff.

Sincerely,

Rebecca W. Hanmer

for Sheldon Meyers
Director
Office of Federal Activities

Enclosure

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AUG 23 1973

Mr. Nathaniel B. Cohen, Director
Office of Policy Analysis
National Aeronautics and Space
Administration
Washington, D. C. 20546

Dear Mr. Cohen:

This is in response to your letter of July 13, 1973 requesting comments on your draft environmental statement for the Viking 1975 Project. The statement is well written and presents the environmental considerations in a clear and concise manner. However, we have a few minor comments concerning the details of the radioisotope thermoelectric generator and its potential effects on marine biota in the event of an aborted mission.

In Table III, under the Viking column, 1) the Generator Internal Gas Fill should be 90 He/20Ar; 2) there is no capsule vent tube and 3) the Electrical Receptacle Seal is "double Viton O-ring." In Figure 4 the drawing should be corrected to eliminate the vent tube. Page 22, 1) change Division of Biology and Medicine to Biomedical and Environmental Research and 2) the presentation of the ecological effects is unclear. This section could be improved considerably if, following an assumed dissolution rate, the author followed a logical order of effects; i.e., water plankton - fish - man, and present the ultimate effects in relationship to an acceptable standard.

This whole section (beginning page 22) should be checked, since it appears to differ with what the marine subpanel reported for SNAP-27/ALSEP. This subpanel reported that 3800 grams of undamaged PuO fuel particles had a rate of solution in seawater of 0.25 Ci. day^{-1} while damaged particles, being smaller, dissolved at the rate of 0.5 Ci. day^{-1}. Furthermore, man's annual protein diet, if obtained entirely from fish, would require 75 kg of protein, from 150 kg of fish.

Sincerely,

W. H. Pennington
by Charles Osterberg

W. H. Pennington
Assessments and Coordination
Officer
Division of Biomedical and
Environmental Research

HEALTH AND
ENVIRONMENT

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

13 AUG 1973

Mr. Nathaniel B. Cohen
Director
Office of Policy Analysis
National Aeronautics
and Space Administration
Washington, D.C. 20546

Dear Mr. Cohen:

We have reviewed NASA Draft Environmental Impact Statement for the Viking 1975 Project and have no comments.

Sincerely,

George W. Milias

George W. Milias
Director for
Environmental Quality

Cu

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN F. KENNEDY SPACE CENTER
KENNEDY SPACE CENTER, FLORIDA 32899

REPLY TO
ATTN OF: MD-B

January 9, 1975

TO: NASA Headquarters
Attn: ADA-I/N. B. Cohen

FROM: MD-B/William H. Lee

SUBJECT: Environmental Impact Statement for Viking 1975 Program

In accordance with our telecon this date, I am forwarding the original correspondence on this subject as received from the State of Florida, Bureau of Intergovernmental Relations.

I would appreciate 15 copies of the final publication to effect required distribution within state agencies.

William H. Lee
Bioscience Staff Office

Enclosure
As stated

DEPARTMENT OF STATE

Washington, D.C. 20520

BUREAU OF INTERNATIONAL SCIENTIFIC AND TECHNOLOGICAL AFFAIRS

August 7, 1973

Nathaniel B. Cohen, Director
Office of Policy Analysis
National Aeronautics and
Space Administration
Washington, D.C. 20546

Dear Dr. Cohen:

This refers to your letter of July 13, 1973 in which you forwarded for our comment a draft environmental impact statement concerning the Viking 1975 project.

The interested offices within this agency have reviewed the draft and have found it to be generally satisfactory. We would, however, urge that treatment on the possible effects of the probes on the Mars environment, including precautions against adverse effects, be expanded for the benefit of the reader, bearing in mind that this will be an unclassified public document. As it is now, the treatment on page 17 is quite abbreviated and we believe a fuller justification should be included of NASA's conclusion that the risks of contaminating the planet are minimal.

Thank you for affording us the opportunity to review this statement.

Sincerely yours,

William C. Salmon for

Chrisitian A. Herter, Jr.
Special Assistant to the Secretary
for Environmental Affairs

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway - IBM Building

TALLAHASSEE

32304

(904) 488-2371

Earl M. Starnes
STATE PLANNING DIRECTOR

Reubin O'D. Askew
GOVERNOR

L. K. Ireland, Jr.
SECRETARY OF ADMINISTRATION

January 7, 1975

Mr. William H. Lee
Bioscience/Environmental Control
Staff Officer
J. F. Kennedy Space Center
Kennedy Space Center, Florida 32899

Dear Mr. Lee:

Functioning as the State planning and development clearinghouse contemplated in U. S. Office of Management and Budget Circular A-95, we have reviewed the following final environmental impact statement: Viking 1975 Program, SAI: #75-0584E.

During our review, we referred the environmental impact statement to the following agencies, which we identified as interested: Board of Trustees of the Internal Improvement Trust Fund, Department of Health and Rehabilitative Services, Department of Natural Resources, and the Department of Pollution Control. Agencies were requested to review the statement and comment on possible effects that actions contemplated could have on matters of their concern. Letters of comment on the statement are enclosed from the Department of Natural Resources. The Department of Pollution Control reported "no adverse comments" via telephone. No additional comments have been received.

In accordance with the Council on Environmental Quality guidelines concerning statements on proposed federal actions affecting the environment, as required by the National Environmental Policy Act of 1969, and U. S. Office of Management and Budget Circular A-95, this letter, with attachments, should be appended to the final environmental impact statement on this project. Comments regarding this statement and project contained herein or attached hereto should be addressed in the statement.

We request that you forward us copies of the final environmental impact statement prepared on this project.

Sincerely,

Ed Maroney

E. E. Maroney, Chief
Bureau of Intergovernmental Relations

EEM/Tcm

Enclosures

cc: Mr. John Bethea
Mr. Charles Blair
Mr. O. J. Keller
Mr. Jay Landers
Dr. Tim Stuart
Mr. William Partington
Mr. Jim Dennis
Mr. Harmon Shields
Mr. Don Spicer
Mr. H. E. Wallace
Mr. Robert Williams
Mr. Estus Whitfield

RECEIVED

DEC 6 1974

Office of the Director
[illegible]

STATE OF FLORIDA

Department of Administration

Division of State Planning

660 Apalachee Parkway

TALLAHASSEE

32304

(904) 488-2371

Earl M. Starnes
STATE PLANNING DIRECTOR

Reubin O'D. Askew
GOVERNOR

L. K. Ireland, Jr.
SECRETARY OF ADMINISTRATION

TO: Mr. Harmon Shields, Ex. Director
Department of Natural Resources
Larson Building
Tallahassee, Florida 32304
Attn: Mr. Jim Smith

DATE: DEC 3 1974

DUE DATE: DEC 17 1974

FROM: Bureau of Intergovernmental Relations

SUBJECT: SAI: 75-0584E

DIVISION OF STATE PLANNING
Bureau of Intergovernmental Relations
DEC 17 1974
RECEIVED
SAI NO. ______

The attached "Advance Notification" of intent to apply for federal assistance is being referred to your agency for review and comments. Your review and comments should address themselves to the extent to which the project is consistent with or contributes to the fulfillment of your agency's plans or the achievement of your projects, programs, and objectives.

If further information is required, you are urged to telephone the contact person named on the notification form. If a conference seems necessary, or if you wish to review the entire application, contact this office by telephone as soon as possible. If you have no adverse comments, you may wish to report such by telephone. Please check the appropriate box, attach any comments on your agency's stationery, and return to IGR or telephone by the above due date. In both telephone conversation and written correspondence, please refer to the SAI.

Sincerely,

Ed Morey

Chief
Bureau of Intergovernmental Relations

Enclosure

****

TO: Bureau of Intergovernmental Relations

FROM: Department of Natural Resources

SUBJECT: Project Review and Comments

- [X] No Comments
- [ ] Comments Attached

Reviewing Agency:

Signature: James G. Smith

Date: 12/16/74

Title: Administrative Assistant

STATE OF FLORIDA

DEPARTMENT OF HEALTH AND REHABILITATIVE SERVICES

Prior Notification and Review System

DIVISION OF STATE PLANNING

JAN 6 1975

Emmett S. Roberts
Secretary

Date: January 3, 1975

MEMORANDUM

REF. NO: DHRS ______ SPDC (SAI) 75-0584E

TITLE Environmental Impact Statement for NASA Office of Space Science Viking 1975 Program (Final)

APPLICANT NASA

TO: Mr. E. E. Maroney, Chief
~~Kenneth Ireland, Secretary~~
Department of Administration

Attn: Don L. Spicer, Chief
Bureau of Intergovernmental Relations

FROM: Emmett S. Roberts, Secretary
Department of Health and Rehabilitative Services

By: Division of Planning and Evaluation

SUBJ: NOTIFICATION OF INTENT TO APPLY FOR FEDERAL FUNDS

The project identified above has been reviewed in accordance with O.M.B. Circular A-95. Action recommended:

- [ ] The project is consistent with the goals and objectives of the Department of Health and Rehabilitative Services. Favorable action is recommended.
- [x] Substantive comments have been received and are summarized in the attached.
- [ ] Conference with applicant is requested.
- [ ] The project is not consistent with the goals and objectives of the Department of Health and Rehabilitative Services. Approval is not recommended for reasons described in the attached.

Attachment (s)

STATE OF FLORIDA

DEPARTMENT OF HEALTH AND REHABILITATIVE SERVICES

Prior Notification and Review System

O. J. KELLER

Secretary

Date: December 5, 1974 JAN 6 1975

SAI NO. RECEIVED

MEMORANDUM

REF. NO: DHRS ____ SPDC (SAI) 75-0584E

TITLE Environmental Impact Statement for NASA Office of Space Science Viking 1975 Program (Final)

APPLICANT NASA

TO: Robert H. Browning, Chief
Bureau of Comprehensive Rehabilitation Planning

FROM: Federal Programs Coordinator, Division of: HEALTH

The proposal identified above was reviewed by:

Ulray Clark

Ulray Clark, Administrator, Radiological & Occupational Health Section, Division of Health — 12/17/74

Reviewer's Name and Title — Date Reviewed

Reviewer's Comments: (Use additional sheet if needed)

The Viking 1975 Mars Lander program will involve the launch of vehicles carrying SNAP 19 power devices. Two vehicles will be launched ten days apart from the Air Force Eastern Test Range at Cape Kennedy in the summer of 1975. Each vehicle will contain two power sources totaling 20,600 curies of plutonium 238. The total launch represents 41,200 curies of plutonium.

The potential radiological consequences of significance to Florida are concerned with an abort during early launch stages resulting in damage to the power sources and dispersal of the plutonium 238. We have reviewed the information on the Viking launch together with information on the Mariner Jupiter/Saturn project scheduled for 1977. Much of this information has been evaluated in terms of previous experience with launches of SNAP 27 devices on the Apollo moon missions. A radiation control center will be in operation during the pre-launch, launch and ascent phases of the missions. The Center will be manned by safety and medical representatives from NASA, DOD, AEC, and EPA. It appears that offsite radiological surveillance by the Federal agencies will be essentially non-existent for this launch and that such surveillance if provided must be provided by the Florida Division of Health, Radiological and Occupational Health Section.

RECEIVED